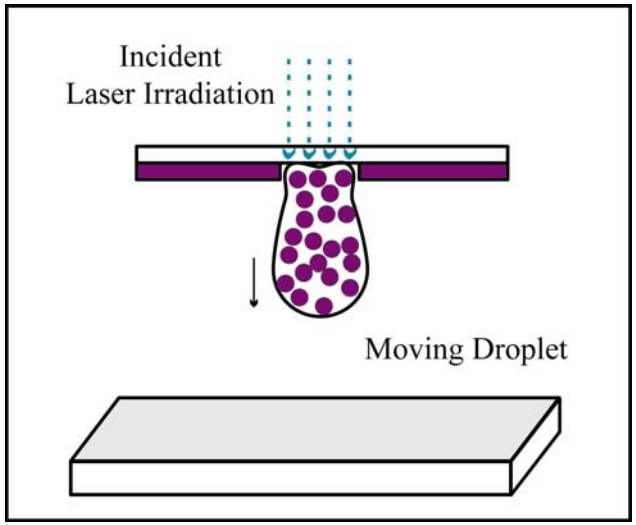
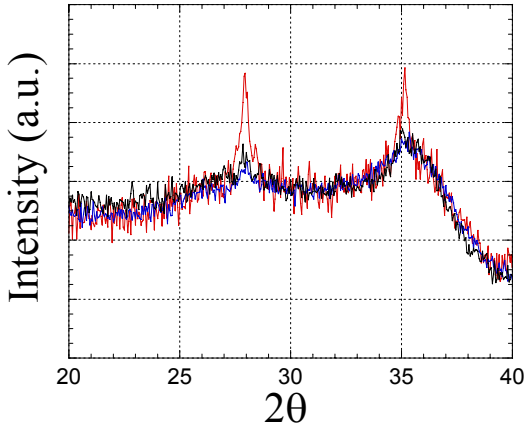
"On-the-fly" Materials Modification During Laser Direct-Write Deposition of Micropower Sources

Craig B. Arnold, Princeton University, DMR-0346497

A recognized need for miniaturized power sources (~1-10 mm^2) exists in national security applications, but the techniques currently available to produce such small power sources require secondary processing such as high temperatures or pressures that can be detrimental to the sensitive materials used in many microdevices. In this study we examine the fundamental materials response of these electrochemically active systems to laser irradiation *during* deposition, in order to understand and control the properties of these substances. Initial results demonstrate the ability to modify the crystallinity of hydrous ruthenium oxide without deleteriously affecting its beneficial chemical or morphological properties.



Laser forward transfer technique for direct-write deposition and modification of electrochemically active materials



XRD showing increase in peak intensity for higher laser energy irradiation (red). (black-initial material, blue-low laser energy irradiation)

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Education:

- The PI has begun involving undergraduates from different academic departments with aspects of this project. Currently, an undergraduate physics major (Adam Hopkins) is being advised for his junior research paper on adaptive optics for materials modifications.
- In addition, the PI is in the process of developing and introducing a new course to the Materials program at Princeton University, *MAE 436: Physical Properties of Materials,* for spring semester 2004. This course builds an understanding of materials response and behavior from the perspective of quantum mechanics and solid-state physics and chemistry.

Outreach:

- The PI has been instrumental in the Materials Research Society (MRS) academic affairs committee, serving as associate chair since September 2003. He has been active in exploring means of widening the appeal of our research society to both graduate and undergraduate students from different disciplines through local student chapters.
- Furthermore, the PI has engaged a small company for collaborative work related to this project, in order to educate and transition the acquired knowledge to the industrial community.